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09/787,062	06/28/2001	Markku Leskela	SEPP9.001APC	1371

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EXAMINER

ANDERSON, MATTHEW A

ART UNIT PAPER NUMBER

1765

DATE MAILED: 01/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/787,062

Applicant(s)

LESKELA ET AL.

Examiner

Matthew A. Anderson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 17 November 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-39 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-39 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 16/31/03
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

**DETAILED ACTION**

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo Jr. et al. (US 5,972,430) in view of Kirlin et al. (US 5,453,494) and Maiti et al. (US 6,020,024).

DiMeo discloses a CVD method for forming multi-component oxide layers. From Fig. 2 is clear that this method is a pulsed method of feeding the reactants into the reactor and then oxidizing them with iterations until the final thickness is deposited. The CVD method is described as an equivalent variant to the related ALE (atomic layer epitaxy) method. The multi-component oxides are described in col. 7 as including BST (barium strontium titanate). The examiner notes that the disclosure of Kirlin et al is incorporated in full into that of DiMeo Jr. et al's. (col. 8 line 53) to describe the chemical Ba and Sr precursors of use. In example 1 in col. 11 is the disclosure of using Si substrates for the growth of BST. In col. 7 lines 1-30 the substrate can be any employed in thin film processing. Oxidants include, according to col. 9 lines 1-15,

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oxygen, ozone, nitrous oxide, nitric oxide, nitrogen dioxide, water vapor, hydrogen peroxide vapor, and mixtures thereof. Plasma activation of the precursors is suggested.

DiMeo et al. does not explicitly suggest using at least one cyclopentadienyl compound of strontium and/or barium in their deposition process as claimed.

Kirlin et al. discloses metal complexes of use in metal-organic CVD (MOCVD). The source reagents of Kirlin have a general formula of  $MA_yX$  as described in the abstract. M is a metal such as Ba or Sr. A is a monodentate or multidentate organic ligand, y is a 2 or 3, X is a monodentate or multidentate ligand coordinated to M and containing one or more atoms independently selected from C, N, H, S, O, and F. The ligand A may be selected from the beta-diketonanes, cyclopentadienyls, alkyls, perfluoroalkyls, alkoxides, perfluoroalkoxides, and Schiff bases. This is more thoroughly explained in col. 4 lines 55+, col. 5 lines 1-62, and col. 8 lines 57+ col. 9 and col. 10 lines 1-20. In col. 8 lines 15-57 the temperature for convenient flow of the precursors of Kirlin is given as less than 200°C and their decomposition is given as over 400°C. This is given as important to reduce premature decomposition in the piping. In col. 43, the precursor gas  $Ti(OP)_4$  is suggested for  $BaTiO_3$  deposition.

Maiti et al. Maiti et al. discloses the annealing of BST to fully oxidize the metal oxide while preventing adverse oxidation of the substrate. (col. 4 lines 15-30) Maiti et al suggests the deposition of BST, St or BT by the various CVD methods and or nanolaminate processing. Nanolaminate processing is described as atomic layer deposition of metals serially in time and allows for composite oxides (i.e. BST) to be formed which comprise one or more metallic oxide materials.

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It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the above references because DiMeo et al. incorporates Kirlin fully by reference and Maiti et al. discloses methods of using atomic layer CVD to form BST composite oxide. Motivation for the combination stems from Maiti which states BST can be deposited in several ways and the combination would expand process flexibility.

In respect to claims 1,6, 7, 27, 28-36, it would have been obvious to one of ordinary skill in the art at the time of the present invention to grow by an atomic layer pulse process an oxide thin film on a Si substrate using the claimed precursor compounds of claim 1 because DiMeo et al. combined with Maiti et al. suggests such an atomic layer CVD process for forming BST and Ti isopropoxide (a known alkoxides; see col. 12 lines 1-10), and Kirlin et al. suggests the using of cyclopentadienyl compounds of Ba and or Sr and reactive oxygen precursors such as ozone or oxygen.

In respect to claims 1,6, 7, 27, 28-36 it would have further been obvious to one of ordinary skill in the art at the time of the present invention to alternately flow the listed reactants and purge with an inert gas to provide self-limited surface reaction because Maiti et al. discloses that such CVD can have the individual reactants flowed in to form atomic layers ( i.e. self-limited thickness) and DiMeo discloses the pulsed CVD using the required precursors.

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In respect to claims 2, it would have been obvious to one of ordinary skill in the art at the time of the present invention to grow dielectric films such as BST or BT (barium titanate) because both are disclosed in both references.

Claim 3 would have been obvious to one of ordinary skill in the art at the time of the present invention because of Fig. 2 of DiMeo Jr. et al.

In respect to claims 20, 37, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the thickness obtained because Fig.2 of DiMeo directly suggests this and such optimization would have been achieved with only routine experimentation.

In respect to claims 4, 38-39, it would have been obvious to optimize the process parameters including the concentrations of the precursors because of the stoichiometry of the desired Ba or Sr containing titanate compound.

In respect to claim 5, 8-13, 21, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use the described cyclopentadienyl because the described  $MAYX$  of Kirlin et al. suggests the  $M(Cp)_2$  or  $M(Cp)_2Ln$  as described in the claims. The bonding of the cyclopentadienyls would also have been expected since Kirlin discloses precursors made up of two or three cyclopentadienyls which are mono or multi dentate and X is disclosed as having one or more of the atoms from the group C,N, H,S, and F.

In respect to claims 14-18, 22-24, it would have been obvious to one of ordinary skill in the art at the time of the present invention that amino, alkyls, hydrocarbons,

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aminespolyamines, biprydines, and other ligands be incorporated into the cyclopentadienyls precursors because such ligands are disclosed by Kirlin et al.

In respect to claim 19, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the film deposition temperature because such is suggested by Kirlin et al. and such optimization would have been achieved with only routine experimentation.

In respect to claims 25 and 26, it would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the anneal of Maiti et al. with DiMeo et al because then one of ordinary skill would be assured of full oxidation of the metal oxide while avoiding substrate corrosion.

Further, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the temperature of the annealing because annealing is nothing more than the application of heat under certain conditions and such optimization would have been achieved with only routine experimentation.

### ***Response to Arguments***

8. Applicant's arguments filed 10/31/2003 and 11/17/2003 have been fully considered but they are not persuasive.

The arguments of 10/31/2003 will be addressed first.

The argument that the process is not taught by the references is not convincing. DiMeo et al col. 1 lines 43-60 discloses that ALE is a form of CVD deposition useful for

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multi-component oxide deposition. In addition the combination of references above discloses purging between growth steps in an atomic layer CVD deposition process indicating to the ordinarily skill artisan a limited process.

The argument that the process of Dimeo is not ALE is not convincing. The examiner notes that Maiti et al. suggests using CVD processing to form atomic layer depositions of BST oxides. Also, DiMeo teaches about 5 angstrom thick layers which in turn suggest an atomic layer process.

The argument that DiMeo only teaches a growth rate of 33 angstroms ignores the suggestion in col. 10 lines 30-40 were the process has multiple cycles (i.e. 5-1000) which produce a certain thickness (i.e. about 20 angstroms to about 20000 angstroms). This suggests in the very least a process capable of 5 cycles with about 4 angstroms deposited each cycle.

The examiner notes that the version of claims added 11/17/2003 does not require saturating surface reactions.

The examiner notes the arguments concerning the references of M. Vehkamki et al., M. Nakano et al., and Bedair et al. However, these references have not been made of record and therefore have not been considered by the examiner.

The argument that there is no motivation to modify or combine DiMeo is not convincing. ALE (a form of CVD according to DiMeo) was suggested by DiMeo et al. of capable of producing limited atomic layers of oxides. DiMeo's process is described as useful for the task of depositing an oxide layer. This is sufficient evidence that ALE and



the CVD of DiMeo are at least equivalents. Regardless, the process of DiMeo suggests the claimed steps and thus renders it obvious.

The arguments filed 11/17/2003 have been considered but are not convincing.

The argument that the process of the claims is distinct from that of DiMeo is not convincing as above.

The argument that the precursor cyclopentadienyls compound is not suggested is not persuasive since DiMeo et al. incorporates by reference the precursors of Kirlin et al. and Kirlin discloses precursors made up of two or three cyclopentadienyls.

The examiner is not persuaded by the argument that the ALE process is self limited while that of DiMeo is not. The applicant ignores the purging of excess precursor in DiMeo et al. One of ordinary skill would conclude that this purging limits the precursor available in the deposition chamber for the oxidation reaction. (See Fig. 2 and its description in cols. 8-11.)

### ***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (703) 308-0086. The examiner can normally be reached on M-Th, 6:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MAA  
January 20, 2004

*SUPERVISOR*  
NADINE G. NORTON  
PRIMARY EXAMINER

